Atmospheric Processes of Alternative Transportation Fuels Using UAM and CALGRID Models

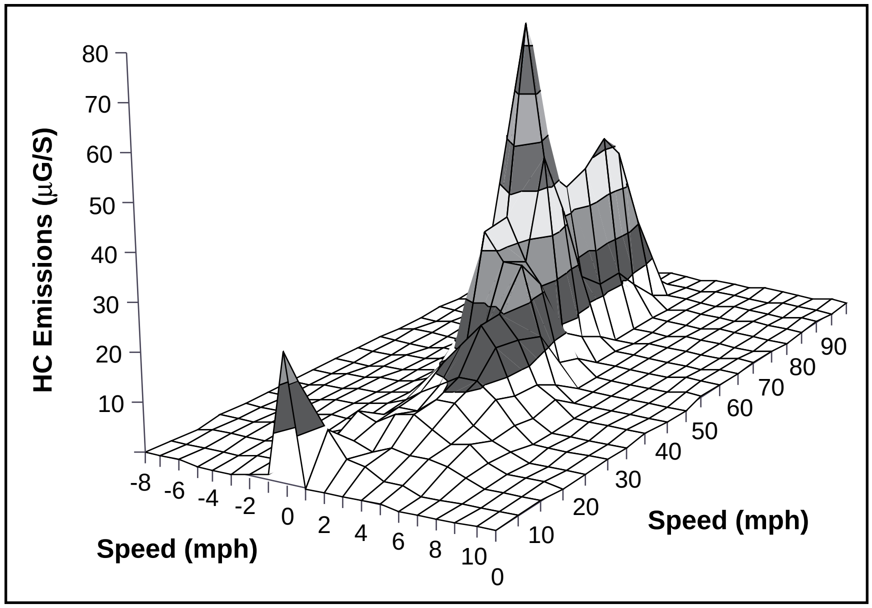

Figure 1: Estimated instantaneous hydrocarbon emissions (micrograms per second) from light-duty gasoline vehicles in Atlanta. Emission estimates are based on EPA (1995) emission tests in 1994 for 125 late-model vehicles and 1992 driving study data (DeFries and Kishan 1993) for 76 vehicles in Atlanta.

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Objective

To evaluate and compare, using photochemical grid models, the potential impacts on air quality of emissions of ozone precursor compounds, toxic air pollutants, and greenhouse gases from alternative on-road motor vehicle transportation fuels. The fuels examined are reformulated gasoline (RFG), compressed natural gas (CNG), and an 85% methanol-15% RFG blend (M85).

Approach

Two photochemical grid models, the Urban Airshed Model (UAM-IV) and the California Grid Model (CALGRID), are being used to evaluate the ozone-forming potential of future motor vehicle emission scenarios for two urban areas, Los Angeles and Atlanta. Based on the State Implementation Plan (SIP) modeling episodes established for each urban area, the modeling scenarios are projected forward to 2007. The ozone modeling will be performed using two chemical mechanisms (CBM-IV in UAM and SAPRC90 in CALGRID) to simulate ozone photochemistry.

The RFG emissions scenario is the base case against which the two alternative fuel scenarios will be compared and evaluated. Motor vehicle emissions in the future year for all three fuels assume complete penetration in the light- and medium-duty vehicle fleet of the most advanced emissions control technology for which emission measurements are currently available. The emission scenarios also include adjustments to the fuel distribution and marketing emissions to account for penetration of the alternative fuels into the marketplace.

Motor vehicle emissions for each scenario include incremental estimates of emissions caused by vehicle operation outside the speed and engine load boundaries of the current Federal Test Procedure (FTP). The FTP is the standard vehicle driving cycle assumed by EPA in developing the current vehicle emission factor models. By incorporating estimates of incremental emissions that result from off-FTP operation, this study attempts to account for potential underestimation in current estimates of on-road vehicle emissions.

Accomplishments

This study is currently in the first phase of a three-phase program. We have prepared vehicle emission adjustment factors for the FTP driving cycle and the off-FTP operations for all three fuels. These emission factor estimates are being used to develop modeling emission inventories for each of the three fuels for both Los Angeles and Atlanta. Once developed, these emission inventories will be input to the UAM-IV and CALGRID models to evaluate the impacts on ozone formation and toxic air pollutant concentrations of each of the alternative fuels.

Future Direction

Future phases of this project will provide detailed examination of differences between the three scenarios resulting from the Phase I modeling activities. In addition, photochemical modeling will be performed for a third urban area and another alternative fuel, liquid propane gas (LPG), will be added to the analysis

Publications

None to date.